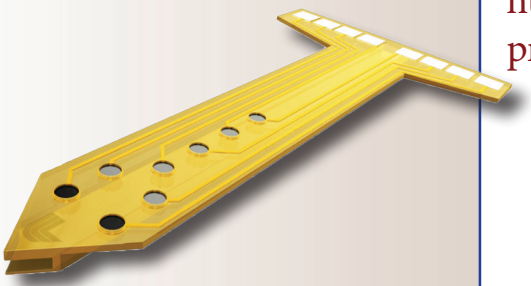
BioEngineering

Lawrence Livermore National Laboratory

Our research is focused on realizing a physiologically relevant ex vivo human model, exploring the frontiers of bioprinting, and creating neural interfaces to unravel the mysteries of the human brain and develop novel therapies for human health problems of involving the human nervous system.



LLNL's multifunctional array contains strategically placed electrodes, chemical sensors, and a microfluidic channel for sustaining and testing live tissue.

This inexpensive blast sensor developed by the Livermore team includes a plastic peak-pressure display and is designed for a single use.

Current Projects

- In-Vitro Chip based Human Investigational Platform (iCHIP)—A biocompatible platform for maintaining the human phenotype for extended periods
- Bioprinting multi-cellular, 3-D microvasculature for maintaining thick tissue survival and function
- Tissue interfaces—Non-toxic, non-invasive measurements for real-time assessment of biochemical and electrical signatures indicative of tissue health
- Implantable neural interface to record and stimulate neurons to treat disorder of the human nervous systems such as neuropsychiatric, memory, hearing, vision, sensory feedback, and other neurologic disorders

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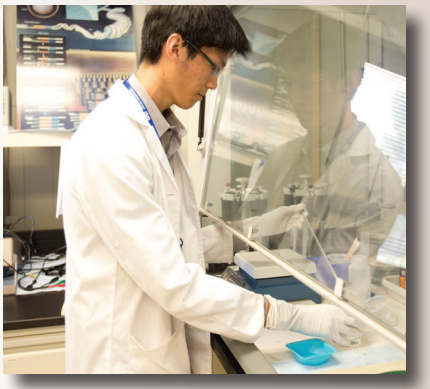
"As humans we can identify galaxies light-years away, we can study particles smaller than an atom. But we still haven't unlocked the mystery of the three pounds of matter that sits between our ears."

— President Barack Obama, introducing the Brain Research Through Advancing Innovative Nanotechnologies (BRAIN) Initiative, April 2, 2013



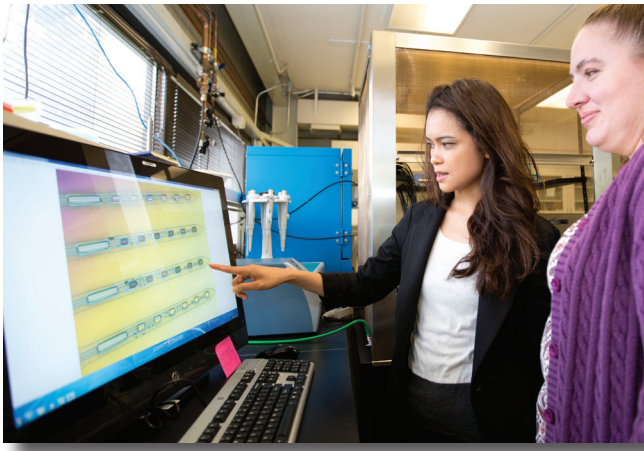
The Center for Bioengineering includes over 1500 square feet of dedicated laboratory space for the development and characterization of next generation brain technologies.

Expertise

- Design, fabrication and characterization of biological micro- and nanosystems
- Packaging and integration of micro- and nanosystems
- High-density interconnect technologies
- Long-term implantable bio-medical devices
- Electrode material development and characterization
- Electrochemical characterization
- Chemical functionalization of microelectrode arrays
- 3-D fabrication technologies and 3-D bioprinting
- Dynamic systems and controls

Facilities

- Dedicated medical device foundry in a certified class 100 clean-room facility (approx. 4,000 sq. ft.) equipped to handle polymers, metals, and dielectrics with tools for deposition, photolithography and patterning, web and dry etching, integration and assembly, and metrology
- Characterization lab for neural interface characterization, electrode and sensor development, and electrical, chemical, and mechanical lifetime testing
- Other LLNL technologies including machine shops, electronics shops, high-resolution metrology centers, additive manufacturing and 3D printing tools, metal joining labs, and polymer fabrication facilities



After microfabrication of polymer multi-electrode arrays, LLNL engineers characterize each electrode for functionality and performance.

Sponsors

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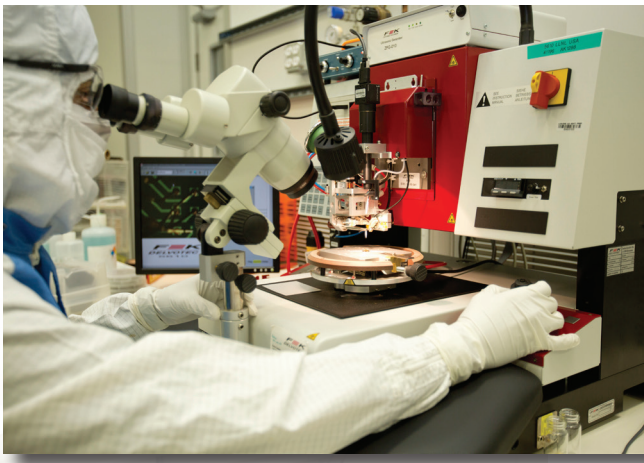

Next generation 3D electronics packaging are performed in a Class 100 cleanroom regulated for biocompatible materials and biomedical devices.

Director

Sat Pannu **925-422-5095** **satpannu@llnl.gov**

Sat is the Director of the Center for Bioengineering and the Section Leader for the Center for Micro- and Nanotechnology. His research focuses on the development of neuromodulation systems including the Artificial Retina, development of ex-vivo human systems, development of autonomous systems for the detection and identification of chemical and biological agents, and novel technologies for micro- and nanofabrication.

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